CLAIMS

What is claimed is:

1. A method for detecting endplates of vertebra, comprising the steps of:

providing a filtered curvature map derived from filtering an intensity curvature map of a spine image in a direction relative to a spine axis;

computing minimum and maximum curvature projections for each point along said spine axis;

at a plurality of points on said spine axis, computing a score from said curvature projections, said score indicating the likelihood that the point is located on an endplate; and

subjecting said score calculation to at least one of the following constraints:

(1) that the angle between neighboring endplates not exceed a certain value; and

(2) that the variation in height of vertebra of said spine image should satisfy a global model.

2. The method of claim 1 wherein said step of computing minimum and maximum curvature projections further comprises the steps of:

computing said spine axis from a spine image boundary;

at each point p along said spinal axis, compute a curve set S_p of all fitting curves passing through point p from one boundary to the other that fit the parabolic equation $y = kx^2 + b$;

deriving said maximum curvature projection as the maximum of the curvature sums along said fitting curves; and

deriving said minimum curvature as the minimum of the curvature sums along said fitting curves.

3. The method of claim 1 wherein said score E is computed from the equation

$$E=\sum_{i=1}^{N} C_{s,\max}\left(e_i\right)+\sum_{V=1}^{V} \max_{p\in\left(e_{2v},e_{2(v+1)}\right)} \{C_{s,\min}\ (p)\}$$

where V is the number of vertebrae, the first term is the sum of the values of said maximum curvature projections at endplate positions, and the second term is the sum of the values of said minimum curvature projections at intervertebral disc positions.

4. The method of claim 3 wherein said score is computed by dynamic programming.

5. The method of claim 4 wherein said dynamic programming comprises the steps of:

obtaining the range of first and last endplates;

using the range of said first endplate and said constraints to determine the range of the next endplate if still within range of said last endplate;

backward tracing through the state space in the dynamic programming optimization of the score to derive a vertebra height profile;

fitting a global endplate height model to an augmented height profile up to a threshold value of the fitting residual;

repeating said step of using said constraints to determine the range of endplates on subsequent endplates until the range of the last endplate is reached.

6. A program storage device, readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for detecting endplates of vertebra, said method steps comprising:

providing a filtered curvature map derived from filtering an intensity curvature map of a spine image in a direction relative to a spine axis;

computing minimum and maximum curvature projections for each point along said spine axis;

at a plurality of points on said spine axis, computing a score from said curvature projections, said score indicating the likelihood that the point is located on an endplate; and

subjecting said score calculation to at least one of the following constraints:

d) that the angle between neighboring endplates not exceed a certain value; and

e) that the variation in height of vertebra of said spine image should satisfy a global model.

7. The invention of claim 6 wherein said step of computing minimum and maximum curvature projections further comprises the steps of:

computing said spine axis from a spine image boundary;

at each point p along said spinal axis, compute a curve set S_p of all fitting curves passing through point p from one boundary to the other that fit the parabolic equation $y = kx^2 + b$;

deriving said maximum curvature projection as the maximum of the curvature sums along said fitting curves; and

deriving said minimum curvature as the minimum of the curvature sums along said fitting curves.

8. The invention of claim 6 wherein said score E is computed from the equation

$$E = \sum_{i=1}^{N} C_{s,\max}\left(e_i\right) + \sum_{V=1}^{V} \max_{p \in \left(e_{2v}, e_{2(v+1)}\right)} \{C_{s,\min}\,(p)\}$$

where V is the number of vertebrae, the first term is the sum of the values of said maximum curvature projections at endplate positions, and the second term is the sum of the values of said minimum curvature projections at intervertebral disc positions.

9. The invention of claim 8 wherein said score is computed by dynamic programming.

10. The invention of claim 9 wherein said dynamic programming comprises the steps of:

obtaining the range of first and last endplates;

using the range of said first endplate and said constraints to determine the range of the next endplate if still within range of said last endplate;

backward tracing through the state space in the dynamic programming optimization of the score to derive a vertebra height profile;

fitting a global endplate height model to an augmented height profile up to a threshold value of the fitting residual;

repeating said step of using said constraints to determine the range of endplates on subsequent endplates until the range of the last endplate is reached.

11. A module for processing spinal images, comprising:

an input for spinal image data;

data processing means for executing program code for detecting endplates of vertebra, said detection of endplates accomplished by a method comprising the steps of:

providing a filtered curvature map derived from filtering an intensity curvature map of a spine image in a direction relative to a spine axis;

computing minimum and maximum curvature projections for each point along said spine axis;

at a plurality of points on said spine axis, computing a score from said curvature projections, said score indicating the likelihood that the point is located on an endplate; and

subjecting said score calculation to at least one of the following constraints:

(3) that the angle between neighboring endplates not exceed a certain value; and

(4) that the variation in height of vertebra of said spine image should satisfy a global model; and

altering said spinal image to indicate the locations of said endplates.